

# California Linderiella

## (*Linderiella occidentalis*)

### Status

**Federal:** None

**State:** None

**Other:** None

**Recovery Plan:** None

**Placer Legacy Category:** Class 3



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### Distribution

#### California

California linderiella (*Linderiella occidentalis*) (Dodds1923) is a fairy shrimp species endemic to California. In the Central Valley, it ranges from near Redding in the north to as far south as Fresno County, with populations more concentrated east of the Sacramento and San Joaquin Rivers. More scattered populations occur through the coastal region from Mendocino to Ventura Counties. (Eriksen and Belk 1999.)

#### Placer County Phase I Planning Area

##### Historical

The historical distribution of California linderiella can only be inferred from the historical distribution of its habitat. Annual grasslands of western Placer County, particularly in the Great Valley ecoregion, probably supported a patchy distribution of the species.

##### Current

The California Natural Diversity Database (CNDDB) lists 25 occurrences of California linderiella within the Phase I Planning Area. The species is distributed throughout the vernal pool grasslands surrounding the Cities of Roseville, Rocklin, and Lincoln.

### Population Status & Trends

#### California

As of September 2002, the CNDDB listed 204 occurrences of California linderiella in California. This species of fairy shrimp has been reported from the following Vernal Pool Regions: Northeast Sacramento Valley, Southeast Sacramento Valley, Santa Rosa, Central Coast, San Joaquin Valley, South Sierra Foothills, and Santa Barbara (California Department of Fish and Game 1998).

California linderiella is the most common anostracan inhabitant of cool, soft-water pools in California's Central Valley grasslands. There have been significant historic losses of vernal pool habitat, and vernal pool habitat continues to be threatened by development (Eriksen and Belk 1999).

### **Placer County Phase I Planning Area**

As of September 2002, the CNDDB listed 25 occurrences of California linderiella within the Phase I Planning Area. Urban development and agricultural conversion threaten the majority of natural vernal pools in the Phase I Planning Area.

Significant public, government, and preserved lands that are known to support populations of California linderiella include the Wildlands Mitigation Bank, U.S. Air Force Lincoln Communications Facility, Orchard Creek Mitigation Bank, Woodcreek Wetland Compensation Area, Aitken Ranch Mitigation Bank, Diamond Oaks Mitigation Site, and The Highland Reserve (Jones & Stokes file data; California Natural Diversity Database 2002).

## **Natural History**

### **Habitat Requirements**

California linderiella inhabit rain-filled, ephemeral pools (i.e., vernal pools) that form in depressions, usually in grassland habitats (Eng et al. 1990). Pools must fill frequently and persist long enough for the species to complete its lifecycle, which takes place entirely within vernal pools. Compared to other endemic, Central Valley fairy shrimp, the California linderiella is the most tolerant of warm water and consequent low dissolved oxygen (Helm 1998). Most pools occupied by California linderiella are vegetated and contain clear water. However, it is not uncommon to observe California linderiella in mud-bottomed pools with slightly turbid water.

Water chemistry is key in determining fairy shrimp occurrence; alkalinity, total dissolved solids (TDS), and pH are some of the most important factors. California linderiella occurs in poorly buffered waters with low alkalinity (13–170 ppm) and low TDS (33–273 ppm) that can regularly fluctuate in from pH 6.2 to 8.5. California linderiella typically occupies reasonably large pools and may occur in roadside ditches in the Central Valley. (Eriksen and Belk 1999.)

### **Reproduction**

Male fairy shrimp visually seek females. The male grasps the female between the last pair of phyllopods and the brood pouch with specialized second antennae. Sperm is released directly into the female's brood pouch during copulation. Following insemination, the female shrimp releases eggs from lateral pouches into the ovisac, where the eggs are fertilized. (Eriksen and Belk 1999.)

Following fertilization, embryo and cyst development begins. Embryonic development ceases when the late gastrula stage is reached. At this point metabolism slows, and the halted embryo is isolated from the environment by development of a many-layered membranous shell. The embryo and the shell comprise the cyst, or resting egg. Females carry the cysts in a brood sac. Cysts are dropped to the pool bottom or remain in the female's brood sac until the female dies; they are capable of withstanding heat, cold, and prolonged desiccation. When the pools fill in the same or subsequent seasons, some, but not all, of the cysts may hatch. The egg bank in the soil may consist of cysts from several years of breeding. (Eriksen and Belk 1999.)

## Dispersal Patterns

California linderiella disperse locally during extremely wet years when individual pools in a complex spill into or are connected with adjacent pools. Long-distance dispersal can result from cysts being carried on the wind and on the bodies or in the guts of larger animals. Cysts, including those still in brood sacs, can pass undamaged and undigested through the digestive tracts of birds (Proctor et al. 1967 cited in Eriksen and Belk 1999); subsequent deposition of fecal matter can result in the inoculation of a new site. Cysts trapped in mud can adhere to the feet and feathers of waterfowl and the hooves and fur of grazing mammals and be transported to the dried mud of different vernal pool complexes (Eriksen and Belk 1999). Cysts may also be transported between pools in the digestive tracts of amphibian predators such as frogs and salamanders (Rogers pers. comm.).

## Longevity

California linderiella can achieve sexual maturity in as little as 31 days after hatching, although the average is 45 days. California linderiella has the longest maximum longevity of the fairy shrimp species endemic to the Central Valley: 168 days (6 months). (Helm 1998; Eriksen and Belk 1999). Helm (1998) determined the average longevity to be 139 days.

## Sources of Mortality

The primary sources of mortality to California linderiella are predation and desiccation. California linderiella often persist until their habitat dries up and the shrimp are left exposed. In addition, both adults and diapausing cysts can be crushed by foot traffic and off-highway vehicles. (Hathaway et al. 1996.)

## Behavior

California linderiella are omnivorous filter feeders that indiscriminately filter particles of the appropriate size from their surroundings. Diet consists of bacteria and plant and animal particles, including suspended unicellular algae and metazoans (Eriksen and Belk 1999).

Adults use eleven pairs of legs, or phyllopods, for locomotion, to filter suspended food particles from their environment, and for respiration.

## Movement and Migratory Patterns

The presence of California linderiella adults coincides with the filling and drying pattern of vernal pool habitats. Typically, populations of adults are present from late December to early May. (Eriksen and Belk 1999). Resting cysts are always present in an occupied pool basin.

## Ecological Relationships

Fairy shrimp are preyed on by migratory waterfowl, amphibians, predatory diving beetles (Coleoptera:Dytiscidae), water boatmen (Hemiptera:Corixidae), and vernal pool tadpole shrimp (*Lepidurus packardii*). Large freshwater branchiopods in California serve as an important source of protein and energy for migratory waterfowl (Eriksen and Belk 1999). Many vernal pools occur along the Pacific flyway; the use of these pools as resting and feeding grounds by migratory birds is well documented (Silveria 1998; Sterling pers. comm.).

California linderiella commonly co-occur with vernal pool fairy shrimp (*Branchinecta lynchi*) and vernal pool tadpole shrimp (*Lepidurus packardii*). California linderiella has been infrequently collected with Conservancy fairy shrimp (*Branchinecta conservatio*) (Eriksen and Belk 1999).

## Population Threats

The greatest threats to the persistence of the California linderiella are habitat loss and degradation resulting from urban development and agriculture. Vernal pools occur in large, flat, open grasslands that are ideal for a number of economic uses including airports, military bases, rice and grain fields, cattle grazing, aggregate mining, and urban development. Many of the suitable vernal pools for this species in the Phase 1 Planning Area have been lost to development.

## References

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### Personal Communications

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